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ANALYSIS OF DEMAND FOR VEGETABLE IN MALAYSIA

by

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ABSTRACT

The market information is important in facilitating marketing system from production to the downstream. The purpose of this study is to estimate the Malaysian consumers' demand for vegetables. By using Household Expenditure Survey 2004/05 data, demands for 6 vegetables are analyzed via a multi-stage budgeting system. The estimated demand elasticities show that the demands for all vegetables are found to increase when per capita income rises. Most of the vegetables are found to respond substantially to changes in their own prices and in the directions as expected with estimated negative own-price elasticities, which is more than unity (except podded vegetable).

Keywords: *Vegetable, multi-stage budgeting system, demand elasticities*

JEL code: D12

1.0 INTRODUCTION

The health benefits of increased consumption of vegetable are clearly documented in the literature. Block *et al.* (1992) indicated that the health benefits are in terms of reduced incidence of various forms of cancer, as well other ailments such as stroke, heart disease, and obesity. However, the consumptions of vegetable in Malaysia are still far behind those developed countries in the Asian region though the per capita consumption of vegetable has been showing increasing trend. Thus, the per capita consumption of vegetable in Malaysia is expected to rise in view on the improvement in the standard of living and the growing health concern among the consumers (Arshad and Hameed, 2007).

The overall increase in the per capita consumption of vegetable was mainly due to increased consumption of cauliflower, cabbage, cucumber, long bean, and red chili. On the foundation of economics theory, own price, prices of closely related products and per capita income are major determinants of demand for the commodities. However, there have been negative issues in the vegetable sector. Chiew (2007) identified that the poor dissemination of price information for vegetable has been recognized as the cause in an ineffective production planning, which has led to wide fluctuations in prices.

The market information is important in facilitating marketing system from production to the downstream. Therefore, the purpose of this study is to estimate the Malaysian consumers' demand for vegetables. Specifically, this study estimates demand elasticities in term of income and price elasticities for major 6 vegetables. The importance of understanding the demand for vegetable consumption would be helpful in assessing Malaysian dietary quality as well as implications for future agricultural trade.

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2.0 LITERATURE REVIEW

There is a literature gap to be filled for demand analysis of vegetable in Malaysia, while the demand for vegetable has been studied extensively in developed countries. Previous studies (Baharumshah and Mohamed, 1993; Nik Mustapha, 1994; Nik Mustapha *et al.* 1999, 2000 and 2001; Radam *et al.* 2005) were conducted with the use of Household Expenditure Survey 1990 data to estimate demand elasticities for food in Malaysia.

Baharumshah and Mohamed (1993) examined the demand for all meat products by using Linear Approximate Almost Ideal Demand System (LA/AIDS). Nik Mustapha (1994) excluded households with zero consumption of meat in estimating the demand for meats and fish by using two-stage budgeting system. The other previous studies by Nik Mustapha *et al.* (1999, 2000 and 2001) and Radam *et al.* (2005) integrated all food commodities in demand system analyses via the LA/AIDS model.

All the previous studies mentioned above used the estimated expenditure elasticities as proxies for income elasticities, which do not conform to the hypothesis in Engel's law. Under Engel's law, as income rises, the proportion of income spent on food falls, even if actual expenditure on food rises. Thus, income elasticity of demand for food must be less than 1[4].

Radam *et al.* (2005) also estimated expenditure elasticities for 20 types of fruits by using Working-leser functional form. The study found that star fruit had the highest expenditure elasticity (1.104) while jackfruit (cempedak) and jackfruit (nangka) recorded the lowest expenditure elasticities (0.257 and 0.225 respectively). However, Bryne and Capps (1996) argued that the Working-Leser functional form inherently imposes restrictions on the elasticity values.

All the previous studies mentioned above also did not censor the zero consumption in the data, which might have led to possible bias created by the presence of zero consumption. Zero consumption happens when households report no consumption during a survey period. To overcome the problem, a two-step Heckman estimation procedure developed by Heien and Wessells (1990) has been empirically applied in previous studies (Gao and Spreen, 1994; Gao *et al.*, 1997; Nayga, 1995; Park *et al.*, 1996; Chern, 2000).

To encounter all the shortcomings discussed above, Blundell *et al.* (1993) suggested that the most appropriate procedure is to estimate multi-stage demand system. This approach made use of the concept of Strotz (1957) who extended the idea of exhaustive expenditures systems to different levels or stages.

3.0 DATA AND ESTIMATION PROCEDURES

This study utilizes the data from Household Expenditure Survey (HES) 2004/2005 obtained from the Department of Statistics, Malaysia. The data in the HES 2004/2005 consists of 14084 sample size. The large number of sample size in the survey provides higher degrees of freedom, which is particularly important for estimating demand elasticities.

On the basis of the economic model, a three-stage utility maximization is assumed to simplify the construction of the decision-making process for Malaysian households. Various recent studies (Blundell *et al.*, 1993; Fan *et al.*, 1995; Gao *et al.*, 1997; Tiffin & Tiffin, 1999; Dey,

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[4] As explained by Holcomb *et al.* (1995), note that $w = pq / y$ w, where p is price of food and q is the quantity of food, respectively. According to Engel's law, $\partial w / \partial y < 0$. But, $\partial w / \partial y = (p / y)(\partial q / \partial y) - (w / y)$. Then $p(\partial q / \partial y) < w$ under the condition that $\partial w / \partial y < 0$. Hence, $\eta < 1$, where η is income elasticity.

2000) have used the multi-stage budgeting framework in estimating the demand functions for disaggregated commodity groups.

In the first stage, a household makes decisions on how much of their total income (expenditure) is to be allocated for food consumption, conditional on household characteristics and the consumption of the non-food goods. Followed Blundell *et al.* (1993), the specific functional form used in the first stage can be written as:

$$\ln(M^h) = \alpha + \beta_1 \ln(SP^h) + \beta_2 \ln(NF^h) + \beta_3 \ln(Y^h) + \beta_4 (\ln Y^h)^2 + \sum_{i \notin Z_1} \beta_i Z \qquad (1)$$

where M^h is food expenditure, SP^h is price index for food, NF^h is non-food expenditure as proxy for price index for non-food, Y^h is per capita total expenditures (incomes), and Z is a vector of demographic variables that include household size and dummy variable of urban.

As equation (1) is an outcome of utility maximization problem, it must observe homogeneity of degree zero in prices and income. The restriction is evaluated at the sample mean and can be stated as:

$$\beta_1 + \beta_2 + \beta_3 + 2\beta_4 \ln y^h = 0 \qquad (2)$$

In the second stage, the household allocates a portion of food expenditure for consumption of vegetable and other commodity groups. The natural approach would be to include purchase of food in the right hand side as repressor. This raises the second major problem, which is simultaneity, given that such purchasing decisions are endogenous. To address this, the predicted rather than actual value is used as repressor.

This instrumental variable approach has been estimated by Blundell *et al.* (1993) and other studies (Fan *et al*., 1995; Gao *et al.*, 1997; Tiffin & Tiffin, 1999; Dey, 2000) via Tobit regression. The estimating equation for stage 2 is expressed as:

$$\ln EG_i^h = \theta_o + \theta_1 \ln PG_i^h + \theta_2 \ln \widehat{M}^h + \theta_3 (\ln \widehat{M}^h)^2 + \theta_4 S_i^h + \sum_{i \in Z_2} \theta_i ' Z \qquad (3)$$

where EG_i^h is aggregate expenditures on vegetable, PG_i^h is price index of aggregate vegetable group, $\widehat{M}^h$ is the predicted value of M^h from stage 1, S_i^h is the price index for *i*th food group, and Z is a vector of demographic variables that include household size and dummy variable of urban.

Then, a probit regression is computed in order to estimate the probability that a given household consumes the individual vegetable in question. This regression is used to estimate the inverse Mills ratio for each household, which is used as an instrument in the second regression. The use of IMRs are also incorporated into the model to correct the possible bias created by the presence of zero consumption (Heien and Wessels, 1990).
In the third stage, the household allocates the aggregate vegetable group expenditure between different vegetable items. Denote the set of food items on the demand side as DF. For $i \notin DF$, the quadratic version of AIDS is (Blundell *et al.*, 1993):

$$s_i^h = \gamma_0 + \sum_{j \notin DF} \gamma_{ij} \ln P_j^h + \gamma 1_i * \ln\left[\frac{\widehat{EG}^h}{ST^h}\right] + \gamma 2_i \left[\ln\left[\frac{\widehat{EG}^h}{ST^h}\right]\right]^2 + \gamma 3_i * IMR_i^h + \sum_{k \notin Z_5} \gamma_i' Z \qquad (4)$$

where s^h is the expenditure share of *i*th vegetable item in the aggregate vegetable group expenditure, P_j^h is price of *i*th vegetable item, IMR_i^h is the estimated value of inverse Mills ratio, and ST^h is an approximation of the AIDS price index, is computed as:

$$\ln ST^h = \sum_{i \notin DF} s_i^h \ln P_i^h \qquad (5)$$

Utility maximization requires that parameters of equation (4) comply with homogeneity of degree zero in prices, symmetry of the Slutsky matrix, and the adding up restriction (budget shares sum to 1). These restrictions are expressed as follows:

$$\sum_j \gamma_{ij} = 0, i, j \notin DF \qquad \text{(Homogeneity)} \qquad (6)$$

$$\gamma_{ij} = \gamma_{ji}; \frac{\gamma 1_i}{\gamma 2_i} = \frac{\gamma 1_j}{\gamma 2_j}; i, j \notin DF \qquad \text{(Symmetry)} \qquad (7)$$

$$\sum \tilde{\gamma} 0_i = 1, \sum_i \gamma 1 = \sum_{i=1} \gamma 2 = 0; i \notin DF \qquad \text{(Adding up)} \qquad (8)$$

For $i, j \notin DF$, let ε_{ij}^h be the own- and cross-price elasticities, η_{iy}^h the income elasticity of food type i, η_{if}^h be the elasticity of food type i to food expenditure to food expenditure, and η_y^h the elasticity of food expenditure to income. The elasticities are (Blundell *et al.*, 1993):

Food expenditure to income:

$$\eta_y^h = \beta_3 + 2\beta_4 \ln y^h \qquad (9)$$

Aggregate vegetable group expenditure to total food expenditure:

$$\eta_{fd}^h = (\theta_2 + 2\theta_3 \ln \widehat{M}^h) * PFD_i^h \qquad (10)$$

*i*th vegetable item to aggregate vegetable expenditure:

$$\eta_{if}^h = \left[\gamma 1_i \frac{2 * \gamma 2_i \ln(\widehat{E}\widehat{G}^h / P^h)}{s_i^h} + 1 \right] \qquad (11)$$

Income elasticity of *i*th food item:

$$\eta_{iy}^h = \eta_{if}^h * \eta_{fd}^h * \eta_y^h \qquad (12)$$

The Marshallian measures of price elasticity:

$$\varepsilon_{ij}^h = \frac{\gamma_{ij}}{S_i^h} - \left[\gamma 1_i + 2 * \gamma 2_i \ln(\widehat{E}\widehat{G}^h / P^h) \right] \frac{s_j^h}{s_i^h} - k_{ij} \qquad (13)$$

where PFD_i^h is the probability aggregate vegetable group is consumed, and may be estimated from the simple proportion; k_{ij} is the Kronecker delta, which is unity for i=j, and is zero otherwise.

4.0 RESULTS

Table 1 presents the parameter estimates of the food expenditure function. Noteworthy is the square term of the per capita income variable which is significantly different from zero. This result shows that the food expenditure function is non-linear and quadratic term is appropriate to be used in the remaining analyses. The coefficient of household size is positive and significant, implying higher level of food expenditure by households with more members compared to smaller household size, *ceteris paribus*. Also, the negative and significant coefficient of dummy variable of urban suggests that households in urban areas spent lesser than rural households on food. The estimated food expenditure elasticity with respect to total income is 0.4661.

Table 1: Estimated food expenditure function, Malaysia, 2004/05

Variable	Dependant variable: Food Expenditure (Per capita)	
	Coefficient	Std. Error
Intercept	-0.4996***	0.0980
Ln (per capita total income)	1.3987***	0.0736
Ln (per capita total income) x Ln (per capita total income)	-0.1787***	0.0137
Ln (stone price index for food)	0.0436**	0.0198
Ln (per capita non-food expenditure)	-0.0478***	0.0047
Ln (household size)	0.0371***	0.0089
Urban dummy	-0.0557***	0.0045
Adjusted R-squared	0.5396	

*** 1% level of significance; ** 5% level of significance

Table 2 reports the estimates of the parameters of the vegetable expenditure function. The food expenditure variable and its square term are significant. This suggests that the response of vegetable expenditure to changes in food expenditure is significant and non-linear. Evaluated at the sample mean, the vegetable expenditure elasticity with respect to food expenditure is 0.7632. The negative and significant household size shows an increase in the size of the family would decrease the per capita expenditure on vegetable. Average per capita vegetable expenditure is also higher for urban population compared to rural population, *ceteris paribus*.

Table 2: Vegetable expenditure function, Malaysia, 2004/05

Variable	Dependant variable: Vegetable Expenditure (Per capita)	
	Coefficient	Std. Error
Intercept	-1.3894***	0.4018
Ln (price of cereal)	-0.0869***	0.0160
Ln (price of meat)	0.0606**	0.0237
Ln (price of fish)	0.0083***	0.0012
Ln (price of milk, egg & fat)	-0.0467***	0.0105
Ln (price of fruit)	-0.0308**	0.0149
Ln (price of vegetable)	-0.0414	0.0281
Ln (price of sugar & beverage)	0.0679***	0.0105
Ln (price of other foods)	-0.0949***	0.0095
[a]Ln (per capita food expenditure)	1.9280***	0.4226
[a]Ln (per capita food expenditure) x Ln (per capita food expenditure)	-0.2922***	0.1113
Ln (household size)	-0.3976***	0.0135
Urban dummy	0.0229***	0.0057
Adjusted R-squared	0.2687	

[a] Predicted value of Ln (per capita food expenditure), obtained from stage 1.
*** 1% level of significance; ** 5% level of significance

Table 3 presents the estimates of the parameters of the vegetable demand system. The square term of the per capita vegetable expenditure variable is significant in most of the vegetable types (except bulb and stem vegetable), indicating that the response of consumption of various types of vegetable to increases in expenditure on vegetable is non-linear. Most of the urban dummy variables (except leafy and salad vegetable) are significant in all the share equations. However, the sign differs in different equations, suggesting that preference patterns for various vegetable types vary between urban and rural. Vegetable expenditure elasticity for individual type of vegetable varies from 1.0172 for the fruiting and flowering vegetable to 0.8972 for the processed vegetable.

Table 3: Estimated parameters of the QUAIDS vegetable demand system, Malaysia, 2004/05

	Leafy & salad vegetable	**Bulb & stem vegetable**	**Fruiting & flowering vegetable**	**Root & tuberous vegetable**	**Bean**	**Processed vegetable**
	Coefficient (Std. Error)	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**
Intercept	0.2734	0.1187	0.1360	0.0566	0.0528	0.3625[c]
	(0.0061)***	(0.0041)***	(0.0043)***	(0.0027)***	(0.0027)***	-
Ln (price of leafy & salad vegetable)	-0.0449	-0.0381	-0.0289	0.0006	-0.0413	0.1526[c]
	(0.0068)***	(0.0046)***	(0.0047)***	(0.0028)	(0.0029)***	-
Ln (price of bulb & stem vegetable)	-0.0242	-0.0242[c]	-0.0022	-0.0103	0.0058	0.0550[c]
	(0.0021)***	-	(0.0027)	(0.0018)***	(0.0018)***	-
Ln (price of fruiting & flowering vegetable)	0.0524	-0.0055	-0.0055[c]	-0.0047	0.0090	-0.0458[c]
	(0.0033)***	(0.0015)***	-	(0.0014)***	(0.0014)***	-
Ln (price of root & tuberous vegetable)	0.0194	0.0163	-0.0066	-0.0066[c]	0.0085	-0.0310[c]
	(0.0043)***	(0.0029)***	(0.0016)***	-	(0.0019)***	-
Ln (price of podded vegetable)	-0.0155	0.0326	0.0427	0.0226	0.0226[c]	-0.1051[c]
	(0.0065)**	(0.0043)***	(0.0043)***	(0.0020)***	-	-
Ln (price of processed vegetable)	0.0128[c]	0.0188[c]	0.0004[c]	-0.0016[c]	0.0047[c]	-0.0350[c]
	-	-	-	-	-	-
Ln (household size)	0.0962	0.0290	0.0659	0.0353	0.0349	-0.2614[c]
	(0.0064)***	(0.0043)***	(0.0043)***	(0.0028)***	(0.0028)***	-
Urban dummy	0.0037	-0.0172	-0.0160	0.0050	-0.0133	0.0377[c]
	(0.0035)	(0.0024)***	(0.0024)***	(0.0016)***	(0.0015)***	-
[b]Ln (per capita vegetable expenditure)	0.0057	0.0000	0.0032	0.0014	0.0006	-0.0110[c]
	(0.0005)***	(0.0004)	(0.0004)***	(0.0002)***	(0.0002)***	-
[b]Ln (per capita vegetable expenditure) x Ln (per capita vegetable expenditure)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000[c]
	(0.0000)***	(0.0000)	(0.0000)	(0.0000)***	(0.0000)	-
IMR	0.2544	0.1279	0.1899	0.1133	0.1197	-0.8052[c]
	(0.0150)***	(0.0045)***	(0.0051)***	(0.0020)***	(0.0020)***	-
Adjusted R-squared	0.0616	0.1080	0.1446	0.2198	0.2395	

[b]Predicted value of Ln (per capita vegetable expenditure), obtained from stage 2.
[c]Significance can not be assessed as there coefficients are estimated by imposing restrictions.
*** 1% level of significance; ** 5% level of significance

Table 4 presents the estimates of income elasticities of different types of vegetable that obtained by multiplying expenditure elasticities that estimated from Stage 1, Stage 2, and Stage 3. The income elasticities vary across vegetable types. Income elasticities for all vegetable types are inelastic, showing that all the vegetables are normal and necessity goods. Fruiting and flowering vegetable (0.3619) has higher income elasticity while processed vegetable has the lowest income.

Table 4: Income elasticities of various types of vegetable

Types of vegetable	Income elasticity
Leafy and salad vegetable	0.3615
Bulb and stem vegetable	0.3557
Fruiting and flowering vegetable	0.3619
Root and tuberous vegetable	0.3617
Podded vegetable	0.3583
Processed vegetable	0.3191

The Marshallian own-price elasticities of various types of vegetable, evaluated at the sample mean are given in Table 5. Most of the own-price elasticities of demand for individual vegetable type are elastic ($|\varepsilon_{ii}| > 1$). The percentage change in quantity demanded is greater than that change in own-price. High priced processed vegetable has the highest (-1.3183) own-price elasticity. The own-price elasticities for podded(-0.7364) are low.

Table 5: Marshallian own-price elasticities of various types of vegetable

Types of vegetable	Own-price elasticity
Leafy and salad vegetable	-1.1340
Bulb and stem vegetable	-1.1741
Fruiting and flowering vegetable	-1.0323
Root and tuberous vegetable	-1.0801
Podded vegetable	-0.7364
Processed vegetable	-1.3183

5.0 CONCLUSIONS

Demands for 6 vegetables, namely leafy and salad vegetable, bulb and stem vegetable, fruiting and flowering vegetable, root and tuberous vegetable, bean, and processed vegetable are analyzed using Household Expenditure Survey 2004/05 via a multi-stage budgeting system. In the first stage, a household makes decisions on how much of their total income (expenditure) is to be allocated for food and non-food goods. Second, the household allocates food expenditure for vegetable and other commodities. Third, the household allocates the aggregate vegetable group expenditure between different vegetable items.

The estimated demand elasticities show that the demands for all vegetables are found to increase when per capita income rises. This result is consistent with the finding in Tey *et al.* (2007), which shows that Malaysian food consumption pattern is moving towards functional foods in response to income growth. On another hand, most of the vegetables are found to respond substantially to changes in their own prices and in the directions as expected with estimated own-price elasticities more than unity (except podded vegetable).

Second wave of 'hypermarketization' has seen more availabilities of hypermarket in Segamat, Banting, Nilai, and other middle-sized towns. More and more fresh produces are purchased by consumers at the hypermarkets, which is attributed mainly by the change in lifestyle and urbanization. Together with the information of the estimated own-price elasticities, the trend of 'hypermarketization' sends a sturdy message to the domestic food supply chain that the core is on cost efficiency and food quality.

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Appendix 1: Estimated expenditure elasticities at each stage of the multi-stage budgeting system for vegetable consumption, Malaysia.

		Elasticity
Stage 1:		
Food expenditure elasticity with respect to total income		0.4661
Stage 2:		
Vegetable expenditure elasticity with respect to food expenditure		0.7632
Stage 3:		
Vegetable expenditure elasticity for individual type of vegetable		
	Leafy and salad vegetable	1.0163
	Bulb and stem vegetable	0.9998
	Fruiting and flowering vegetable	1.0172
	Root and tuberous vegetable	1.0166
	Bean	1.0072
	Processed vegetable	0.8972

Note: All the expenditure elasticities are estimated at the sample mean.